

# Assessing risk in an unpredictable world



*Surge from Hurricane Sandy crashes over a sea wall in Kennebunk, Maine on October 29, 2012*

**Judy Gates, Director, MaineDOT Environmental Office**

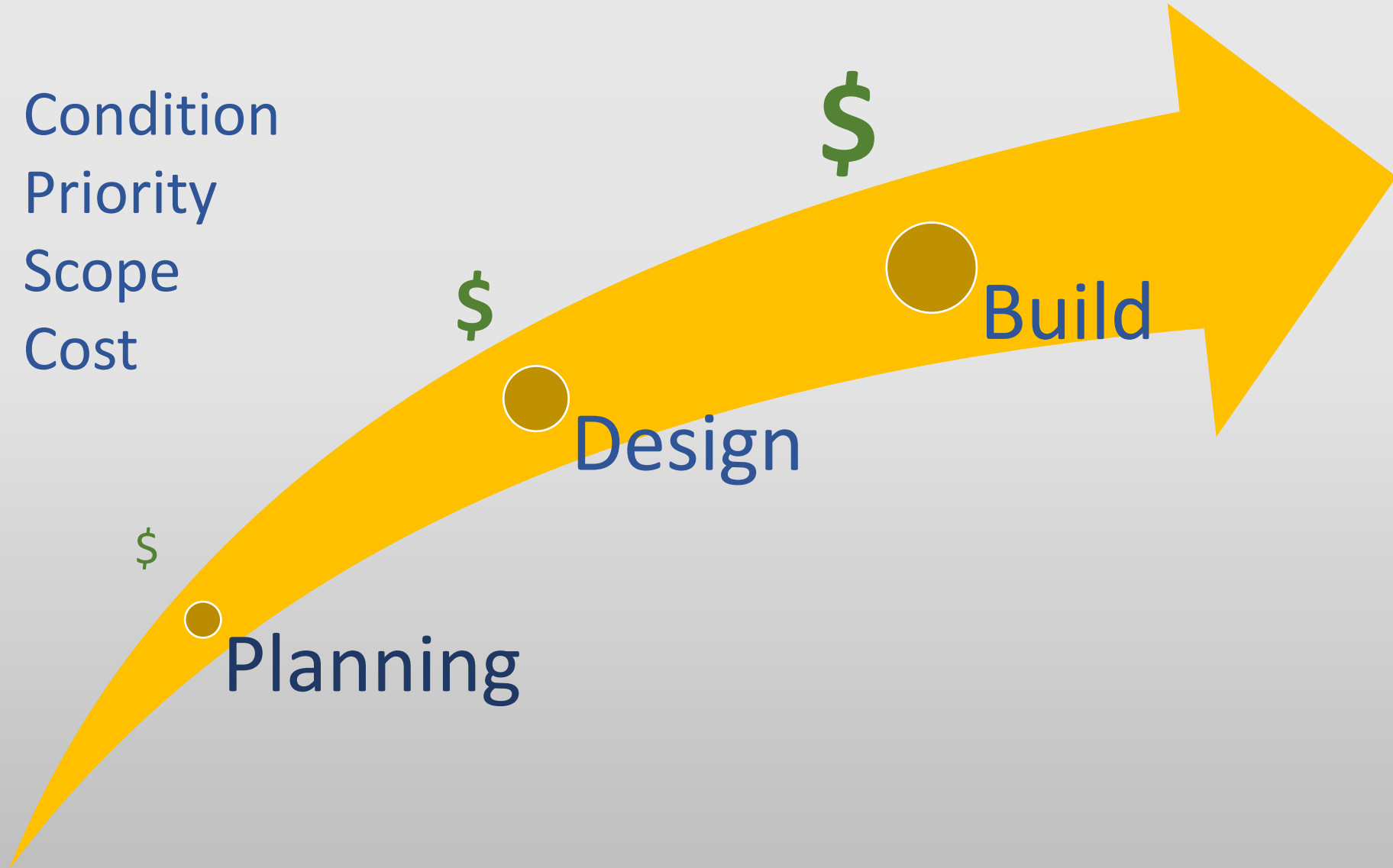
**Maine Partners in Emergency Preparedness**

**April 21, 2015**

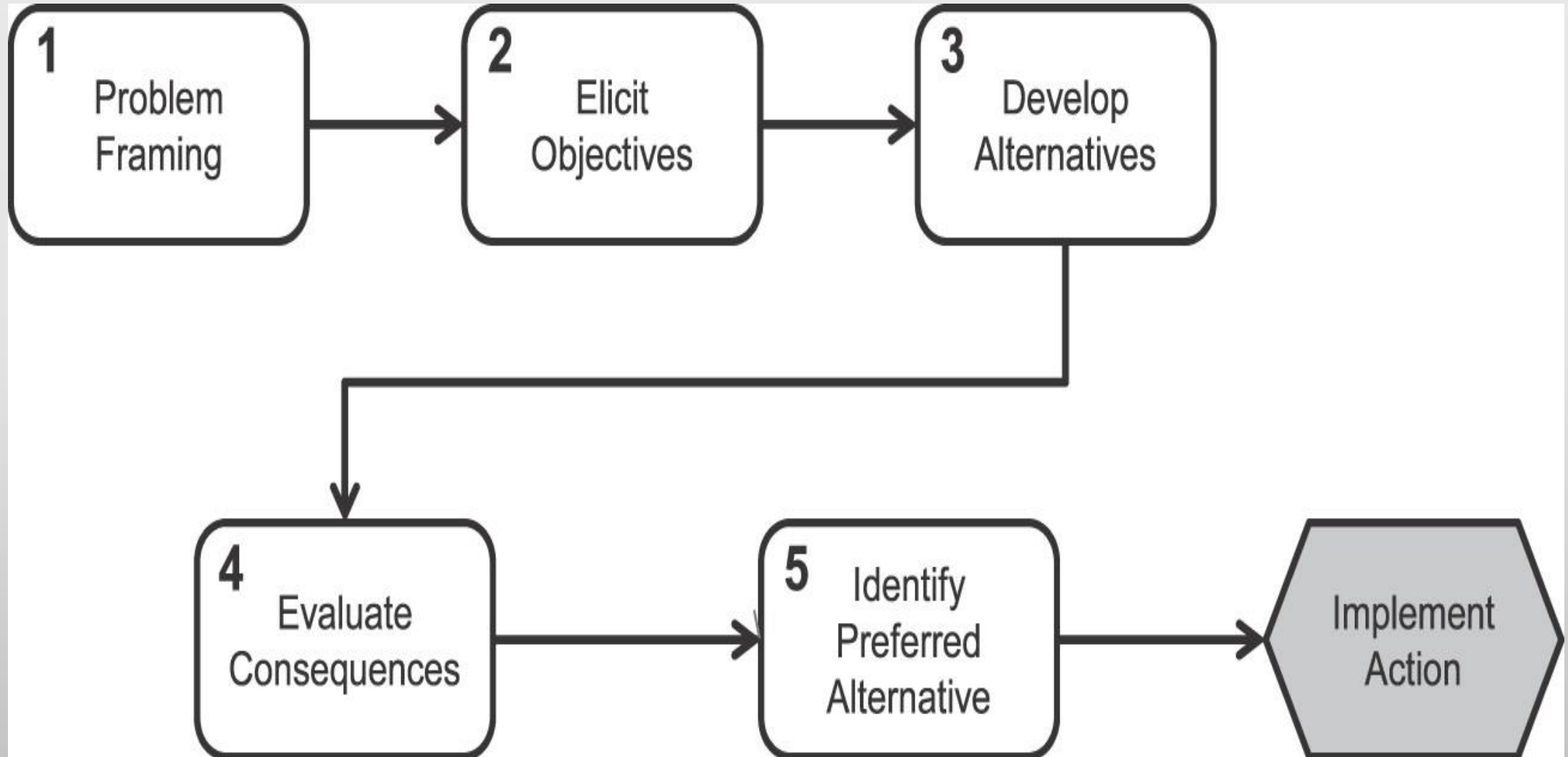


# Engineering Project Timeline

- Condition
- Priority
- Scope
- Cost

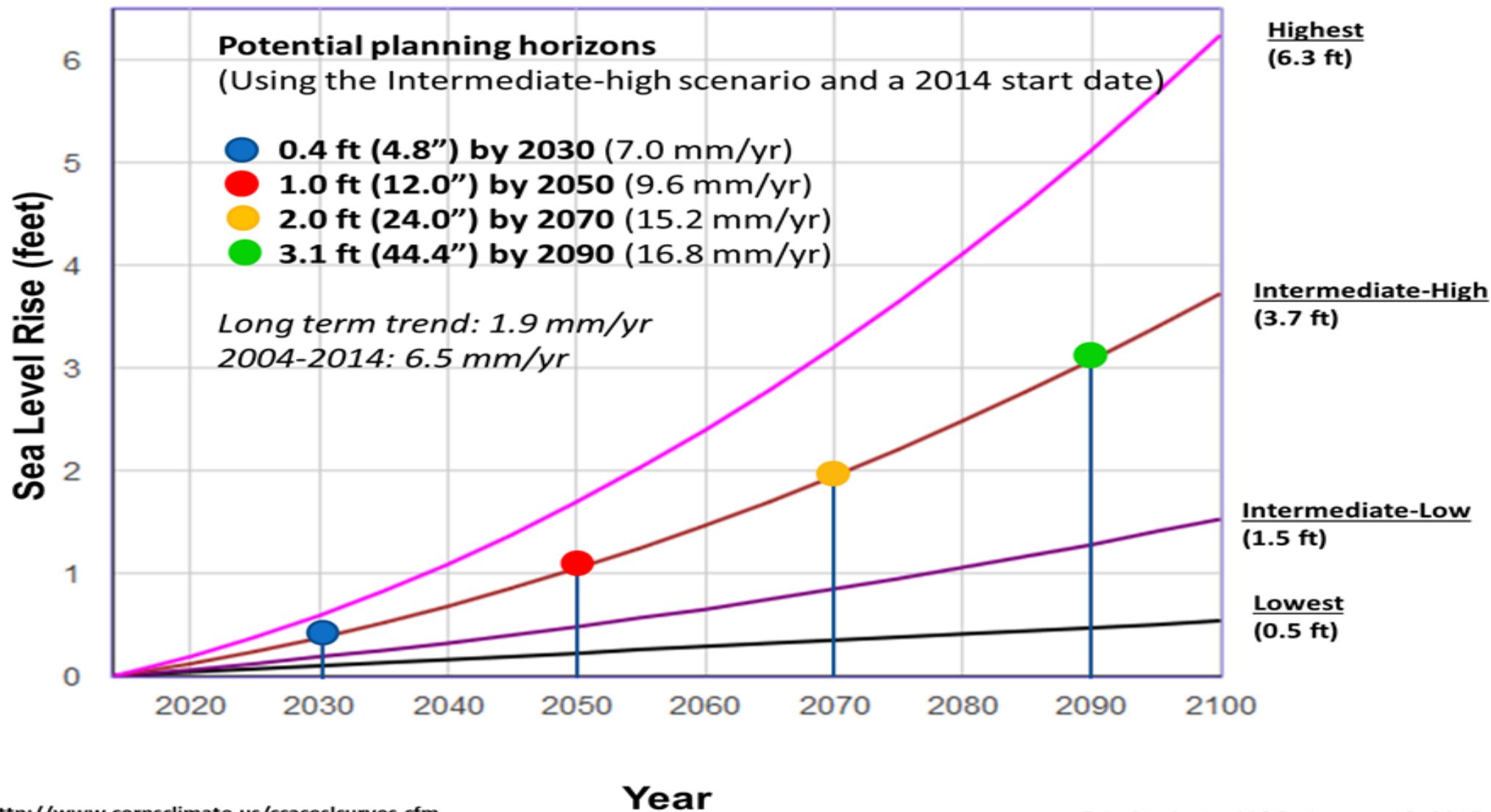


# Structured Decision-making

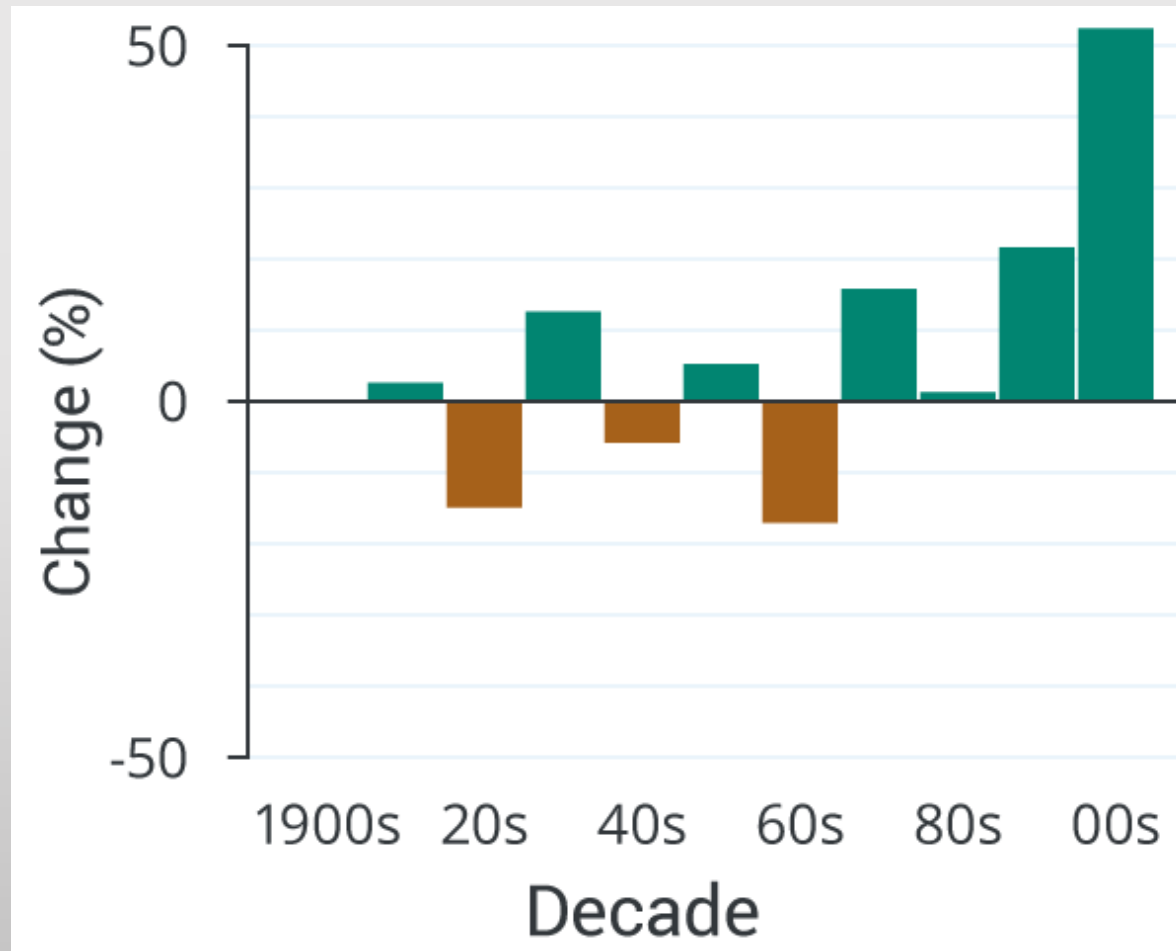


Runge, MC. 2011.

## Sea Level Rise Projections for Portland, ME



# Northeast Observed Change in Heavy Precipitation



# The Lingo

**Vulnerability** = What will get wet, when, and for how long?

**Criticality** = Will we be able to get where we need to go?

**Capacity** = Are we nimble enough?

**Resiliency** = What kind of damage will there be?

**Green Infrastructure** = Will nature help or hurt?

**Risk** = [probability of event x probability of failure] x consequences



# Risk “Multipliers”

- Extreme weather
- Increased precipitation/runoff
- Sea level rise
- Unpredictable funding
- Politics

**= Uncertainty**



Carrabassett Valley bridge failures, Irene, 2011

# Organizational Risk

[probability that a project schedule/budget will fall apart

x

probability that a decision will not be “right”]

x

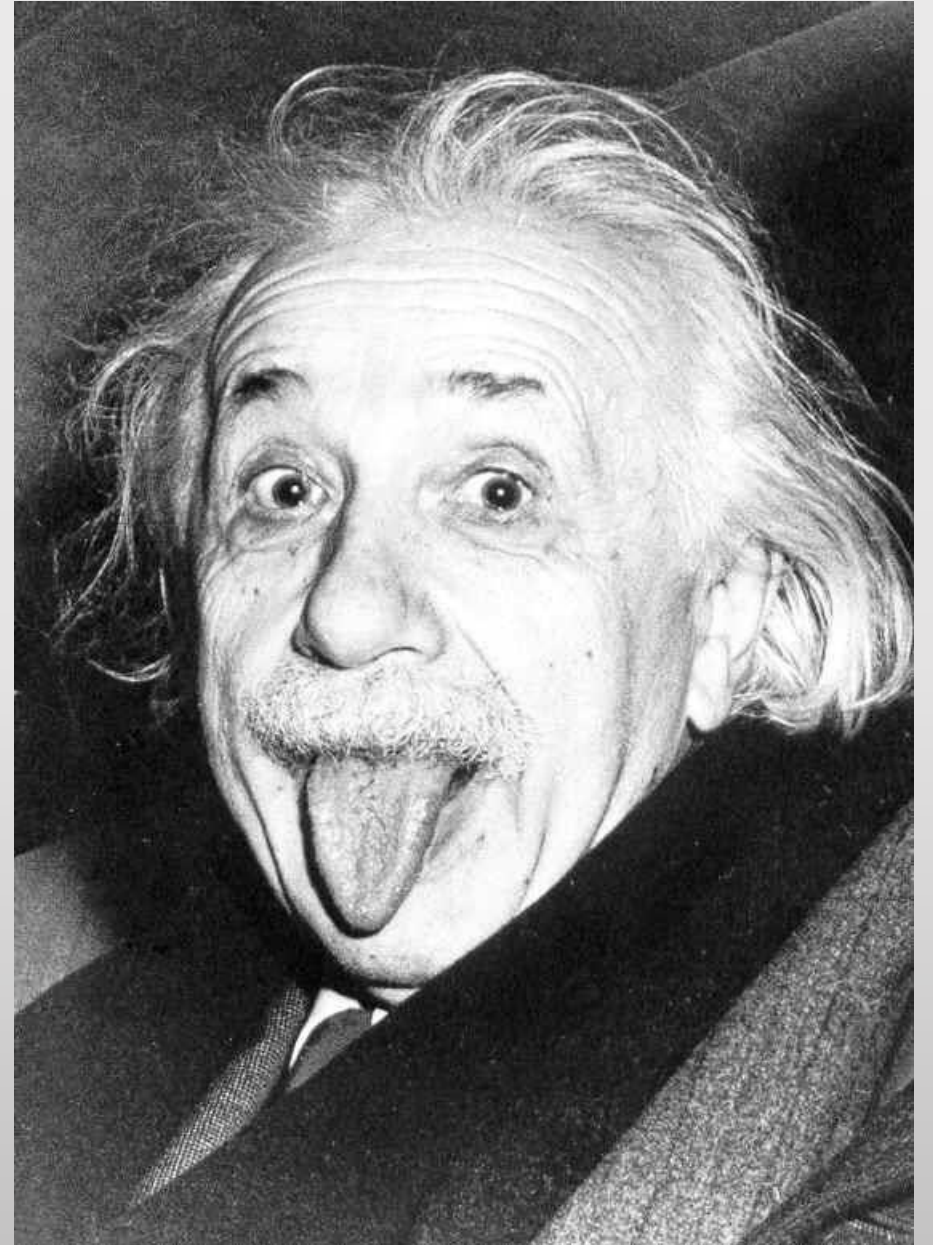
political consequences



# Insanity

Doing the same thing  
over and over again and  
expecting different  
results.

Albert Einstein



# What the conversation is about...

- When will the next big storm hit?
- How big will it be?
- What should we protect first?
- What do customers expect?
- How much will it cost?
- Who is going to tell us how to engineer our way out of this?



FHWA Order 5520

*Transportation System Preparedness and Resilience to  
Climate Change and Extreme Weather Events*

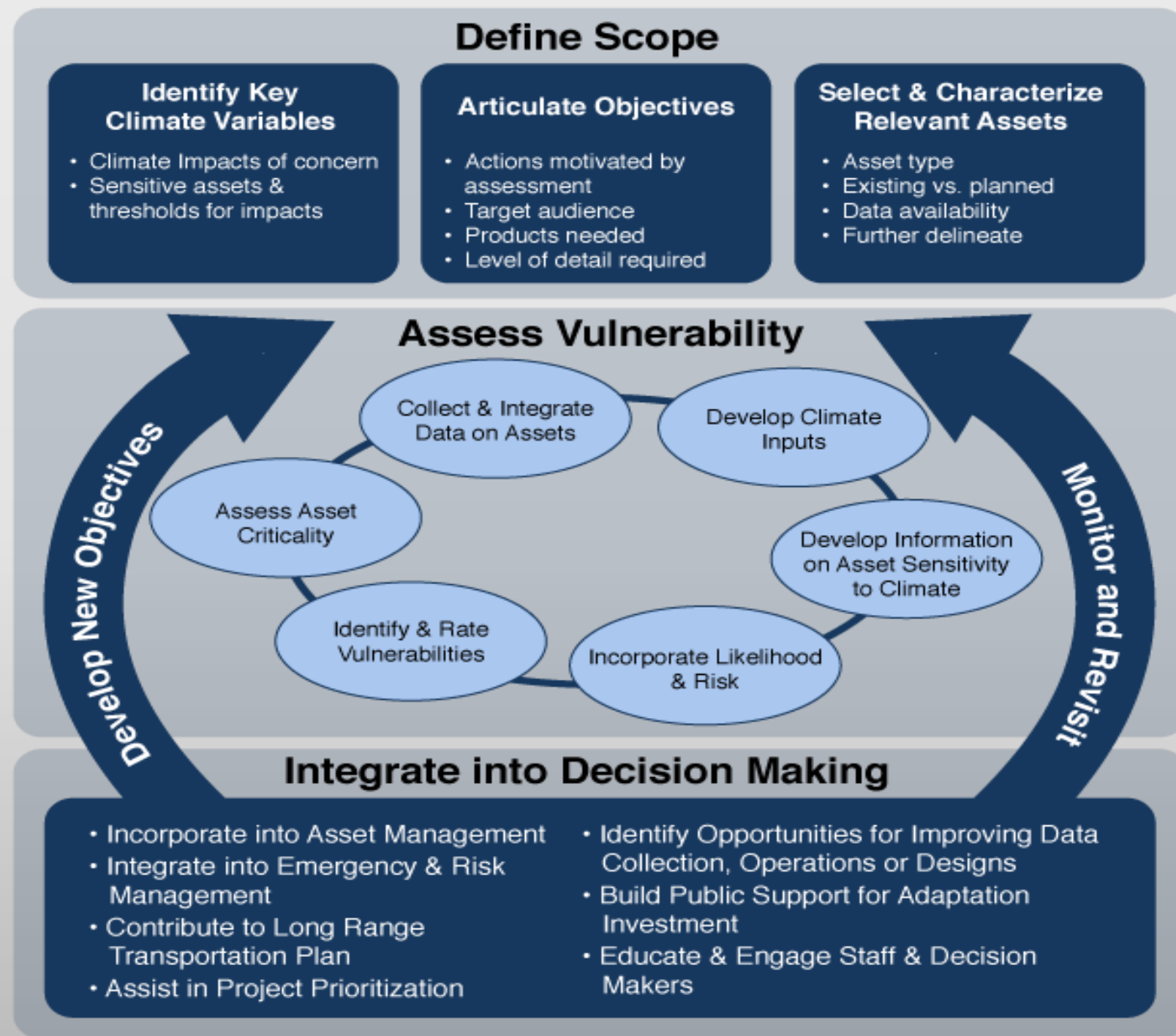
December 15, 2014

EO 13690 (modifies EO 11988)

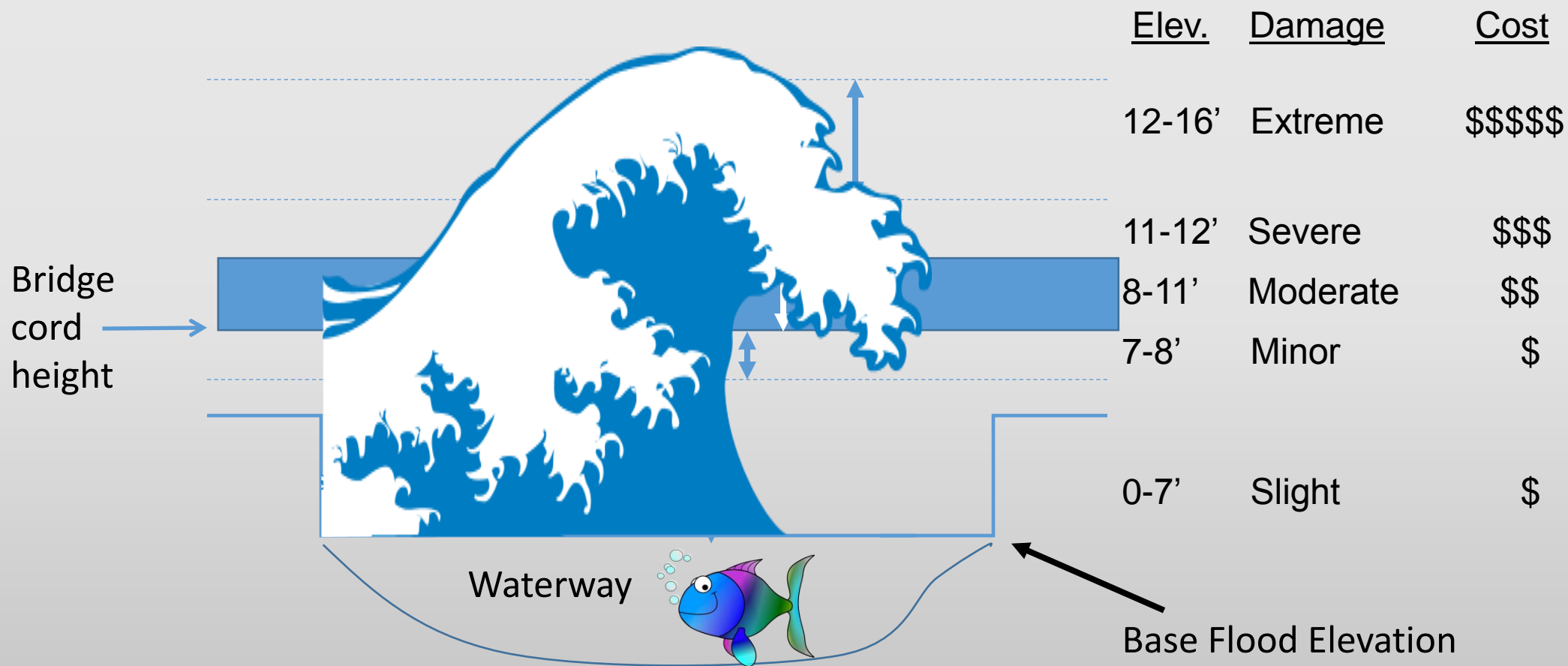
*Establishing a Federal Flood Risk Management  
Standard and a Process for Further Soliciting and  
Considering Stakeholder Input*

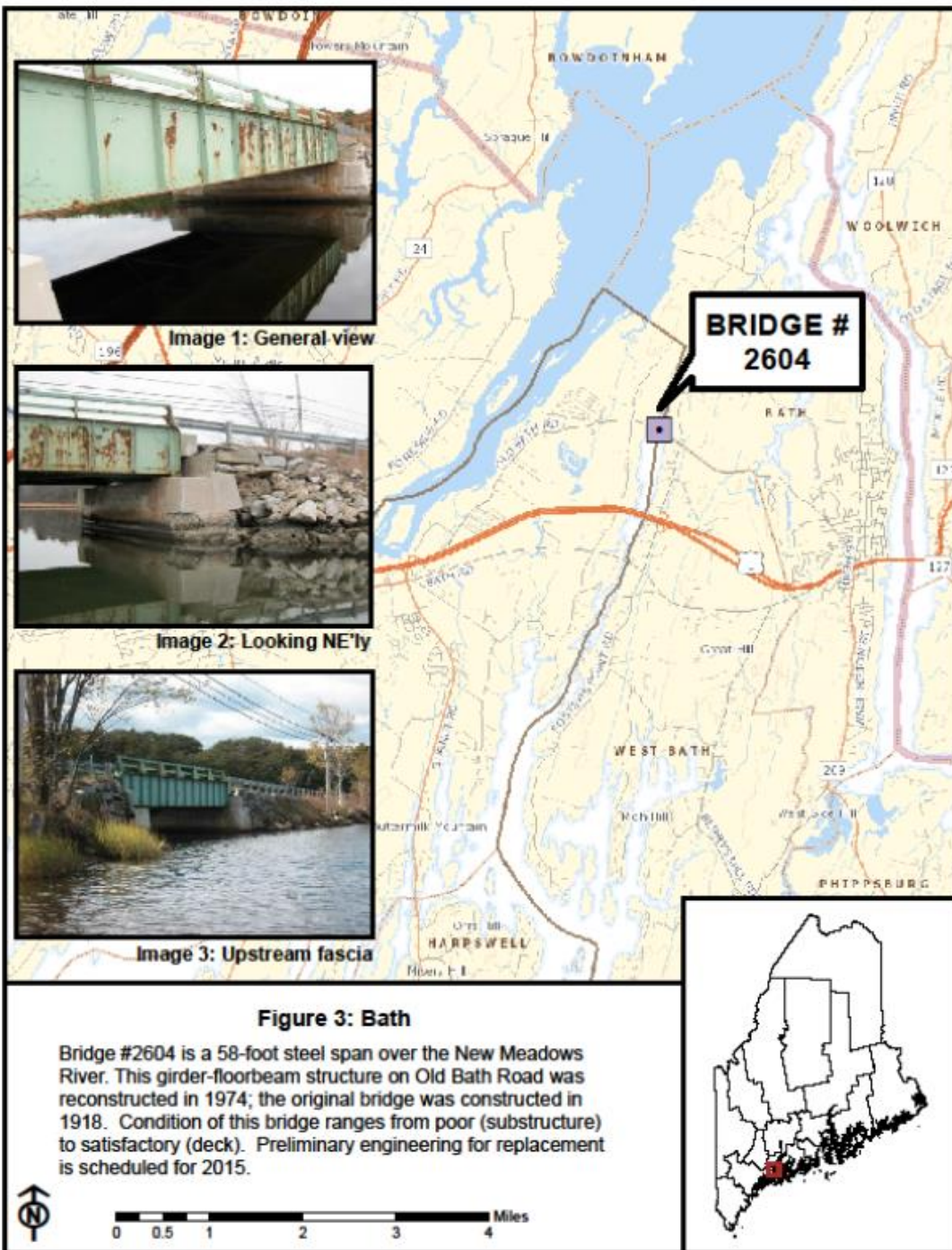
January 30, 2015

# FHWA Adaptation Framework



# T-COAST Depth Damage Functions for Each Structure





## Low Sea Level Rise (3.3')

TOTAL LIFE CYCLE COST BY 2100		
Initial Construction Costs	Total Damage/Repair Costs by 2100	
\$ 400,000	\$697,476	<b>\$1,097,476</b>
\$ 594,000	\$697,476	\$1,291,476
\$1,000,000	\$281,242	\$1,281,242

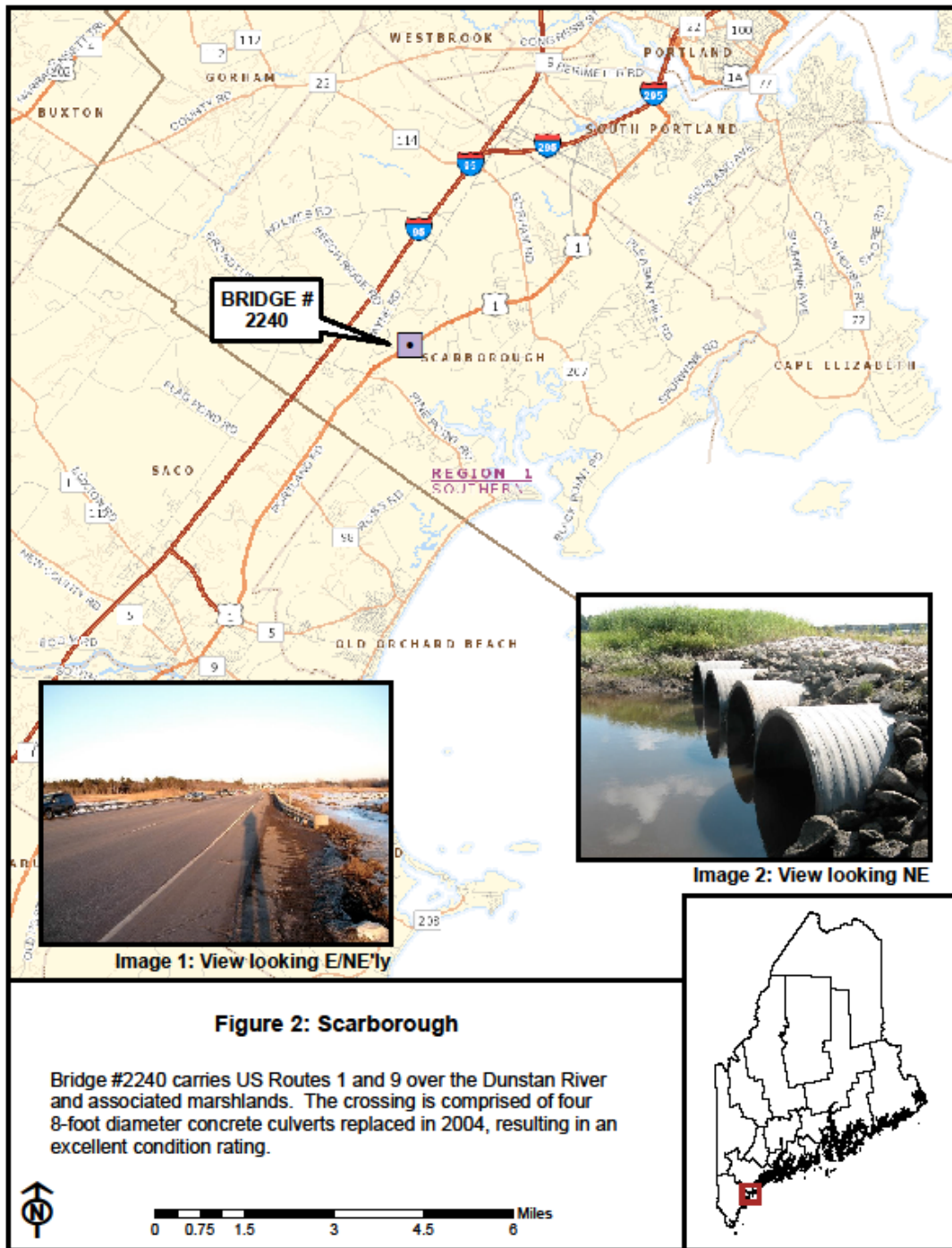
## High Sea Level Rise (6')

TOTAL LIFE CYCLE COST BY 2100		
Initial Construction Costs	Total Damage/Repair Costs by 2100	
\$ 400,000	\$1,867,580	\$2,267,580
\$ 594,000	\$1,867,580	\$2,461,580
\$1,000,000	\$ 916,598	<b>\$1,916,598</b>

## Using the lingo...

1. Identify **vulnerable** infrastructure
2. Select **critical** transportation structure
3. Rank asset **priorities** within each town
4. Run “highest priority” assets through **climate-based scenarios**
5. Pick most cost-efficient, **resilient** alternative
6. Make “**smart**” infrastructure decisions

...all done, right?



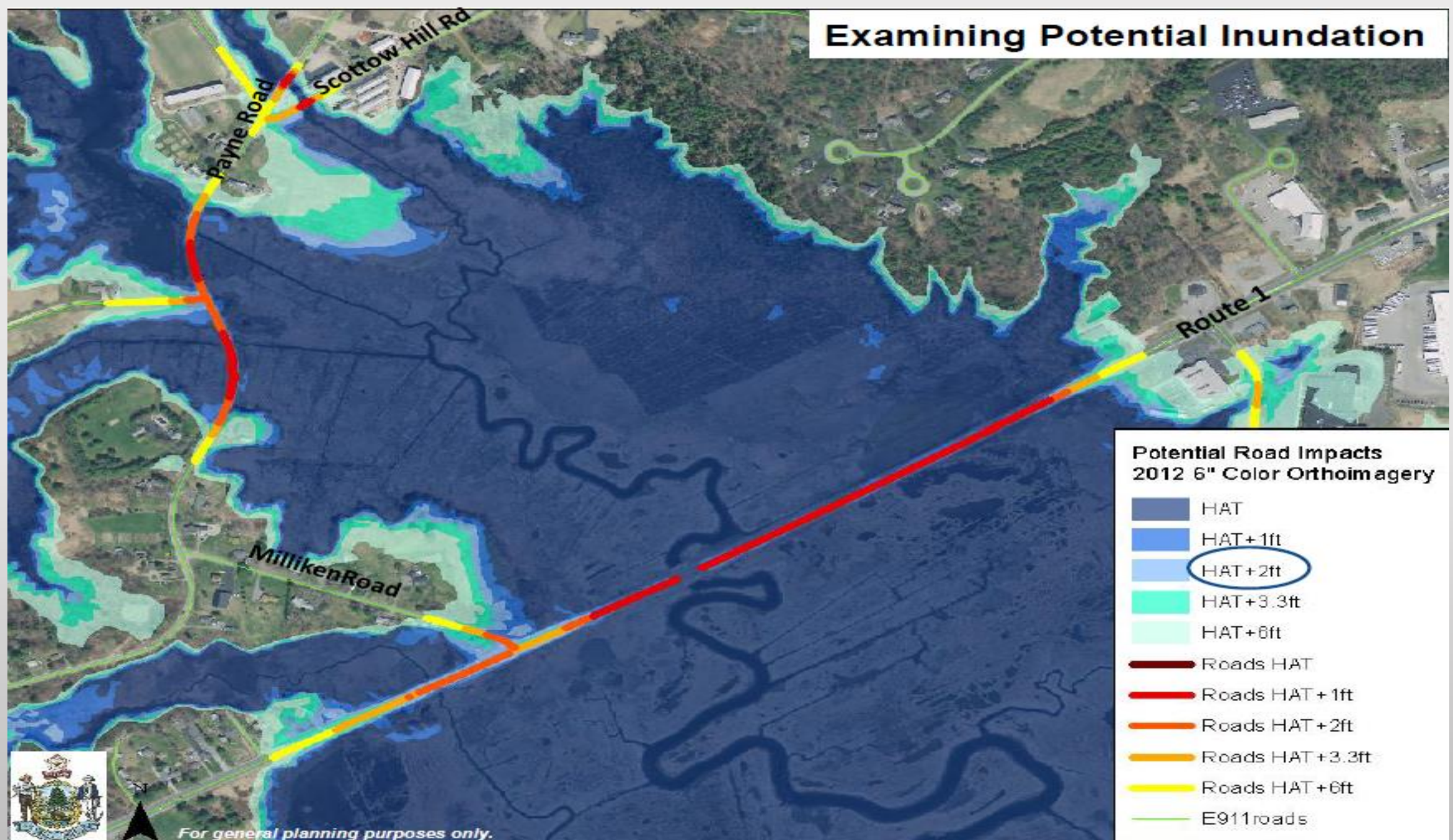
## Low Sea Level Rise (3.3')

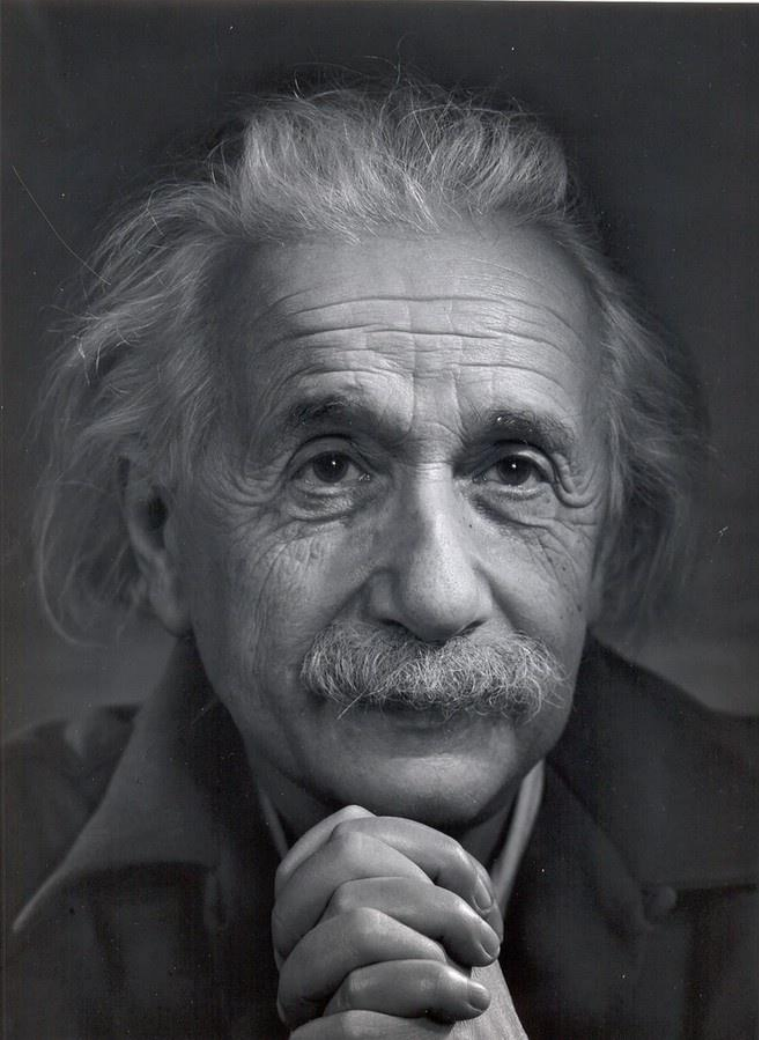
Costs	Total Damage/Repair Costs by 2100	TOTAL LIFE CYCLE COST BY 2100
	\$ 349,128	<b>\$3,949,128</b>
	\$ 181,330	\$4,481,330
	\$ 3,323	\$6,003,323

## High Sea Level Rise (6')

Costs	Total Damage/Repair Costs by 2100	TOTAL LIFE CYCLE COST BY 2100
	\$ 823,325	<b>\$4,423,325</b>
	\$ 642,948	\$4,942,948
	\$ 69,547	\$6,069,547

# Examining Potential Inundation



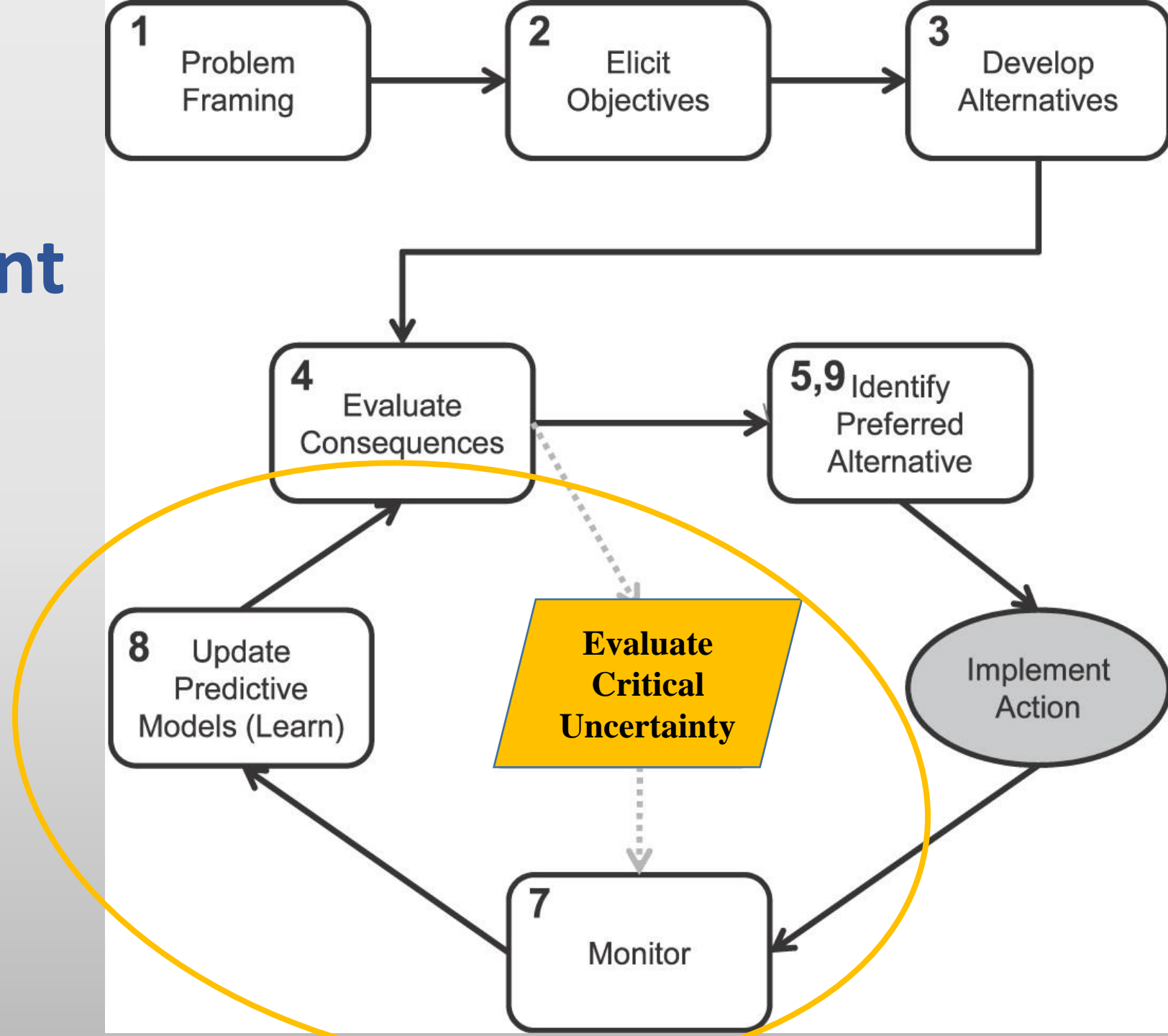


**A wise man once said...**

You can't solve a problem at the same level of consciousness that created it.

Albert Einstein

# Adaptive Management



Runge, MC. 2011.

## New Question: What does “adapt” mean?

- Reinforce it
- Replace it
- Relocate it
- Remove it

# A few things we do know...

- It took over 200 years to get here, so it may take 50-100 years to develop our way out
- Analysis paralysis is not an option
- Adapting can be iterative
- The more real-time and forward-looking a risk assessment is, the more controllable the objective
- Remember when...

# A few things we might know...

- What type of risk...  
SLR? Storm surge? Rain events? Stormwater?
- How long will the feature be at risk...  
Permanently? During severe weather? Rarely?
- Timeframe for increasing risk...  
100 years? 50 years? A decade? Any day?
- Technical assessment is preferable to outrage

## A few things we can't know...

- Intensity of the next severe climate-related event?
- What “butterfly effects” will result from our adaptation efforts?
- Will it be enough or too much?

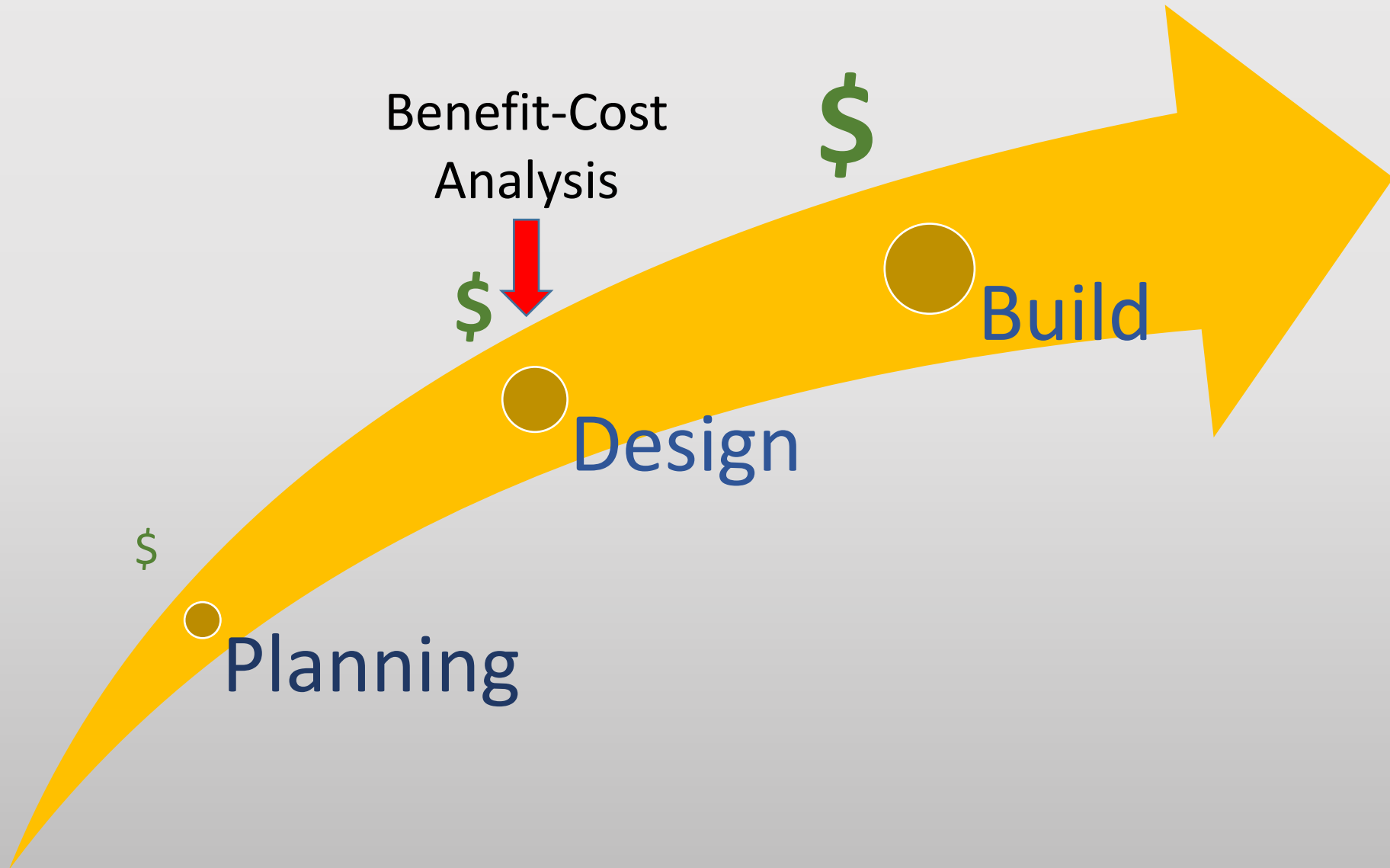
# IMPLEMENTATION

# PLANNING

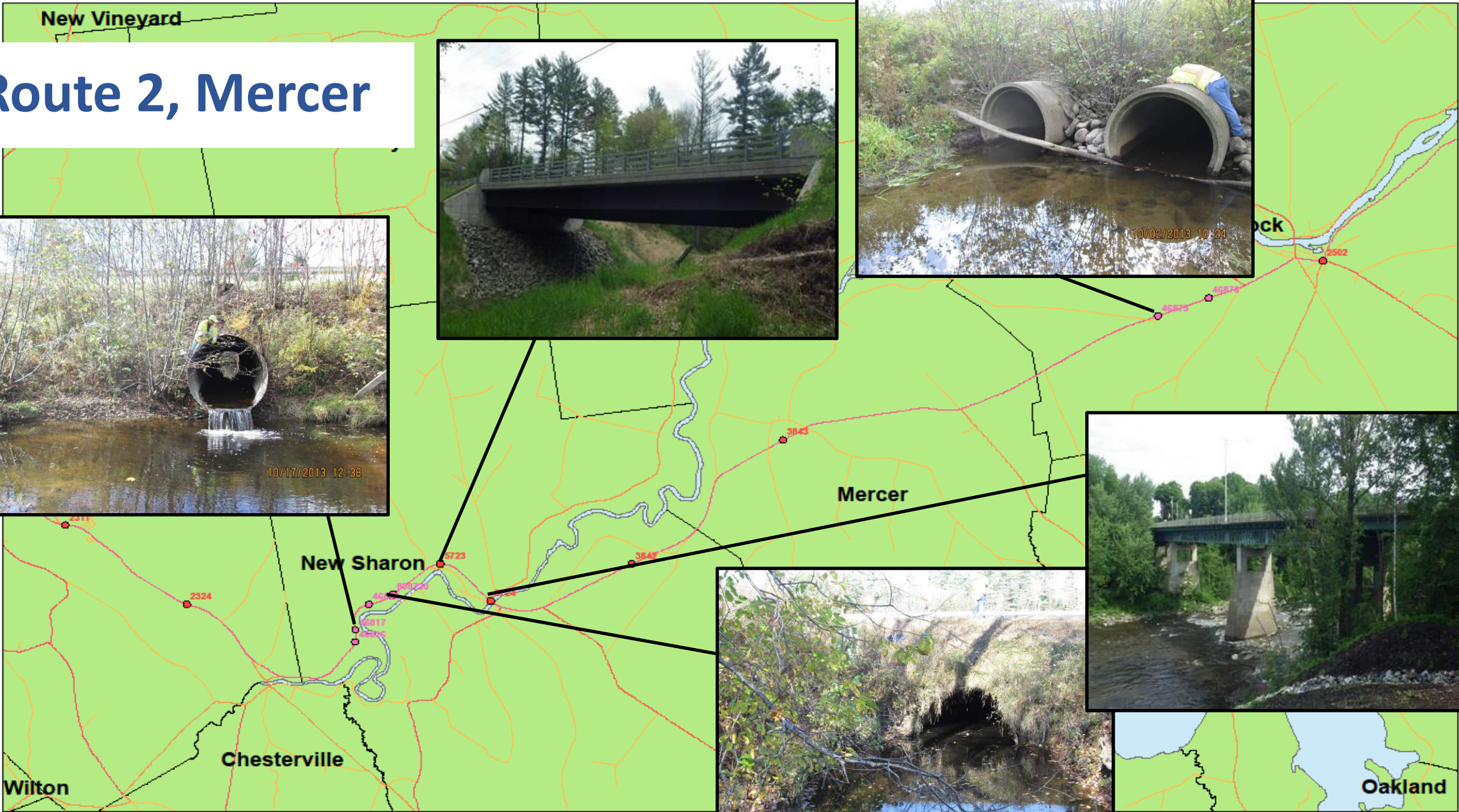
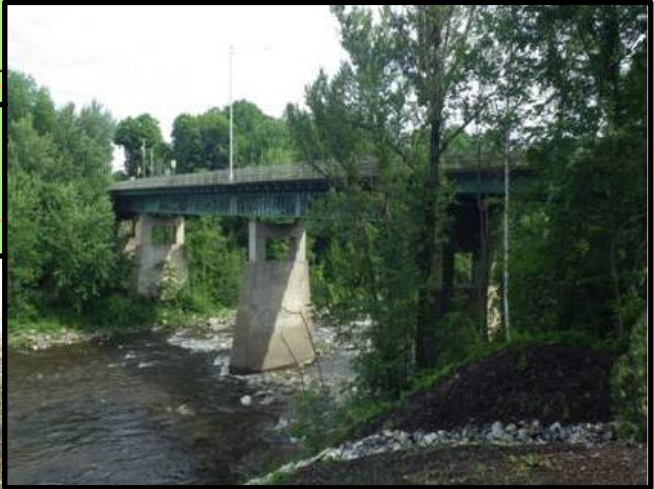


Image courtesy of Renjith Krishnan at FreeDigitalPhotos.net

# Engineering Project Timeline



# Route 2, Mercer



0 0.3 0.6 1.2 1.8 2.4 Miles

RLM

7



# Adding context...



- Ecological
  - Atlantic salmon, EBKT
  - Mapped stream barriers
  - Wildlife passage

- Hydrologic/Hydraulic
  - Watershed size
  - 100 year flows
  - Flooding history

- Structural
  - Condition
  - Scour
  - Size
  - Depth of cover

- Landscape
  - Dominant land use
  - Water quality



# Back to that conversation...

Q: When will the next big storm hit?

A: **Next century, next decade, next week...**

Q: How big will it be?

A: **There is no way to know**

Q: What should we protect first?

A: **Use the best data and know-how**

Q: What do customers expect?

A: **100% accessibility, 100% of the time**

Q: What is the risk tolerance on cost?

A: **zip, zero, zilch**

Q: Who is going to tell us how to engineer our way out of this?

A: **Not it**



# Current Practices



## Bridges:

- 90% full at Q50
- Check that Q100 runs full, but not over road surface
- Check scour to Q500

## Culverts:

~~➤ Sized for Q50~~

- 90% full at Q50
- Full at Q100
- Check 1.2 bank full width

# New Federal Flood Risk Management Standard



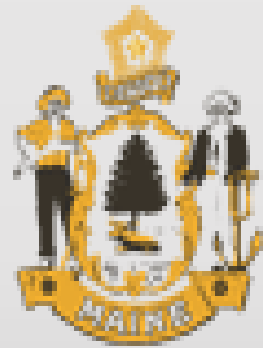
- Build 2 feet above the 100-year flood (1% annual chance) elevation
- Build to the 500-year (0.2% annual chance) flood elevation
- Use data and methods informed by best available, actionable climate science



# The road ahead...

- **Risk resistant** is the goal, not risk-proof..."no regrets" decision-making
- Decisions will have to be made under some level of **uncertainty**
- Lack of catastrophe breeds **complacency**
- See **opportunity** in necessity
- The "**eaten by wolves**" factor (Randy Pausch)
- It only takes a small **adjustment** to avoid the iceberg





***MaineDOT***